

of Kleinschmidt and Zahn (1959). The 2 spreading conditions are the aqueous spread which contains no denaturing agent and the urea formamide spread which contains the denaturing agents urea and formamide. RNA or DNA molecules which are double-stranded will appear the same under both conditions, but those molecules which are single-stranded will appear clumped under aqueous spreading conditions and extended under the urea formamide spreading conditions. The single-stranded molecules are not extended without denaturing conditions because they have numerous intramolecular bonds. Thus not only the nature of the molecules but also the measurement of their length can be determined after spreading them under both conditions.

The second method of analyzing the nucleic acid molecules is by velocity sedimentation centrifugation. The RNA is radioactively labeled with tritium and applied to a 10–30% (v/v) glycerol gradient. After centrifugation, fractions are collected and samples from each fraction are taken and counted in a Packard scintillation counter to measure the amount of radioactivity. The activity of each fraction can be analyzed and the size of the molecules calculated.

These techniques are important for determining the length and size of the DNA and RNA molecules. They were used also to study the nature of the RNA from a mutant of USV thought to have double-stranded RNA as its genome. The results of the 2 techniques complement each other.

A Preliminary Annotated Bibliography of Information Handling Activities in Biology

Richard H. Foote and Judith Zidar

Systematic Entomology Laboratory, IIBIII, Agricultural Research Service, USDA, Beltsville, Maryland 20705

ABSTRACT

A selected bibliography containing about 300 references to information handling activities in the biological sciences is presented. Each reference is annotated to indicate subject matter. The bibliography generally excludes a) articles that are limited to *Homo sapiens* and his disorders, b) many articles published before 1965, c) general texts and papers not specifically related to biological subjects, and d) most references not in the mainstream of the biological literature.

During the past several years biologists have awakened to the need for finding better ways to handle the rapidly growing amount of information they use and generate. This need has been expressed by a few, but the lack of concerted action in this direction has been an ever-growing source of concern to many biologists.

The disciplines of biology vary so greatly in their subject matter and methodology that a centralized effort to establish a truly comprehensive information "system" in biology may never succeed. Nevertheless, progress toward solving information handling problems has advanced in varying degrees from discipline to discipline, and in some

cases it is evident that quite satisfactory solutions are well on the way toward being made. In the large picture, BIOSIS of Biological Abstracts has made impressive progress toward the control of the biological literature, but other areas of activity have hardly been touched upon by biological scientists.

In a very real way the following bibliography represents a recorded summary of progress made to date by the biological community in various areas of information handling. It is intended to indicate the outstanding specific efforts made in several biological disciplines, and it presents sources of information about the more comprehensive activities in biology. At the same time it emphasizes those areas in which more concerted activity seems to be indicated (e.g., the use of microform by biologists).

Exclusions

The user of this bibliography should be aware of its limitations:

1. *References dealing largely or exclusively with Homo sapiens and his origins, development and disorders* have been excluded. However, an occasional reference in this subject matter area is included because a described system or project may provide information applicable to organisms other than humans (see Eichhorn and Reinecke, 1970, concerning the Vision Information Center, which is known to deal in part with information concerning vision in insects and other animals).

2. *In large part, references to general works, including textbooks, that do not deal specifically with the subject matter of biology.* These include books and papers dealing with the principles governing the generation, use, and effective handling of information not related to a specific biological discipline. (In excluding such works, we recognize that we may be doing an injustice to the reader, but this immense body of literature has been or is being covered elsewhere and

is beyond the scope of the present work.)

3. *References that might be difficult for biologists to obtain or use.* This includes most foreign-language publications; most articles that appear solely in the literature of information science; and many notes, comments, published letters, addenda, etc., relating to specific biological subjects that are hardly understandable without reference to some larger, more comprehensive work.

4. *Many articles on the subject that were published before 1965,* a date we regard as a turning point in information handling activity in biology.

Almost no bibliography, no matter what the subject, escapes the shortcoming of failing to include everything of significance. This collection is no exception. Wherever we have excluded a significant reference by oversight, we tender our sincere apologies. Where we have deliberately excluded an article or area of activity, we hope the users of this article will argue their point with us privately or in the press. In either case, an effective future revision of this compilation will depend largely on your comments and cooperation.

Subject Matter Classification and Annotations

Each entry in the following bibliography is annotated in accordance with the following subject matter classification:

A. General

1. State-of-the-art, problems, need for improvement.
2. Descriptions of broadly based (organizational) information efforts.
3. General texts.

B. Primary publications

1. State-of-the-art, problems, need for improvement.
2. Surveys of primary publications

by discipline, descriptions of core literature.

C. Secondary literature information activities

1. Description of primary-secondary relationships and need for improvement.
2. Cataloging and indexing, including discussions of indexing terms, subject headings, thesauri, etc.
3. Abstracts.
4. Descriptions of secondary systems, subject-matter content, methodology, critiques.

D. Data information systems

1. Descriptions of systems, subject-matter content, methodology, critiques.
2. Descriptions of computer programs.
3. Management of collection, museum, and specimen data.
4. Surveys, automated mapping procedures.
5. Automated identification procedures.
6. Automated catalogs, taxonomic catalogs.
7. Bionumeric codes.

E. Personal information systems

1. Mechanical.
2. Automated.

A section following the bibliography accumulates all of the references within each of the subject-matter categories listed above.

Acknowledgments

Several individuals reviewed a preliminary draft of the manuscript, thereby guiding us very effectively in producing the present version: Ross H. Arnett, Jr., Siena College, Loudonville, N.Y.; Robert Chenhall, Strong Museum, Rochester, N.Y.; Gordon Gordh, SEL, IIBIII, ARS, USDA, Washington,

D.C.; Karl Heumann and Philip Altman, FASEB, Bethesda, Md.; H. E. Kennedy, BIOSIS, Philadelphia, Pa.; Irvin Mohler, BSCP, George Washington University, Washington D.C.; Stanwyn Shetler, Smithsonian Institution, Washington, D.C.; and Susan Trauger, University of Wisconsin, Madison.

Theodore J. Crovello, University of Notre Dame; Peter Rauch, University of California at Berkeley; and Roy Shenefelt, University of Wisconsin, very kindly allowed us to select items at will from their extensive personal bibliographies. Without their help, the publication of this bibliography would not have been possible.

The editors also express their appreciation for the invaluable assistance of Ms. Patricia Espenshade, SEL, whose care in the preparation of this manuscript was indispensable.

A Preliminary Annotated Bibliography of Information Handling Activities in Biology

- ADAMS, R. P. 1974. Computer graphic plotting and mapping of data in systematics. *Taxon* 23: 53-70. D5
- ADDISON, C. H., R. W. SHIELDS, and J. W. SWEENEY. 1969. What is GIPSY? Univ. of Okla. Comp. Center. 8 pp., mimeo. D1, 2
- ADDOR, E. E., V. E. LAGARDE, J. K. STOLL, and H. K. WOODS. 1974. A user-accessed computer information system for environmentally sensitive wildlife. Vol. 1. Tech. Rept. M-74-6, U.S. Army Engin. Waterways Exp. Sta., Vicksburg, Miss., 115 pp., illus. (NTIS AD-787 258). D1
- ALBRECHT, C. W., and R. V. SKAVANL. 1974. A flexible computer program for the production of insect labels. *Great Lakes Entomol.* 7: 27-29. D1, 3
- ALVERSON, RHODA A. 1964. An evaluation of the pesticide literature—problems, sources, and services. *Am. Chem. Soc., 147th Nat'l Mtg., Phila., Pa., April 9, pp. 204-208.* B1, 2
- ANDERSON, P. K. 1966. The periodical literature of ecology. *BioScience* 16: 794-795. B2
- ANDERSON, S. 1962. Problems in the retrieval of information from natural history museums. *Proc. Congr. Data Acquis. Proc. Biol. Med., p. 55-57.* C2, D3
- ANDERSON, S., and R. G. VAN GELDER. 1970. The history and status of the literature

- of mammalogy. *BioScience* 20: 949-957. B1, 2; C1, 4
- ANON. 1954. The Chemical-Biological Coordination Center of the National Research Council. National Research Council, Washington, D.C., Sept., 33 pp. A2, D1
- . 1963. Terminology of malaria and of malaria eradication. Report of a drafting committee. WHO, Geneva, 127 pp. C2
- . 1967. Some characteristics of primary periodicals in the domain of the biological sciences. ICSU Abstracting Board, Paris, 84 pp. B1
- . 1969. Information Center Profile—Science Information Exchange (SIE). *Sci. Info. Notes* 1: 43-46. D1
- . 1970a. Information Center Profile—National Oceanographic Data Center. *Sci. Info. Notes* 2: 129-132. D1
- . 1970b. Natural history information retrieval system. Smithsonian Institution. 25 pp., mimeo. D2, 3
- . 1970c. Canadian scientific information system. *InterAmer. News* 3: 4-5. A2
- . 1972. Communications in neuroscience. *Neuroscience Newsletter* 3: 4-6. A2, C4.
- . 1973. Bug counting, computer style. *Farm Chemicals*, April, pp. 39-42. (for details, see Atmar, *et al.*, 1973). D1, 5
- . 1974. Trends, priorities, and needs in systematic and evolutionary biology. *Syst. Zool.* 23: 416-439, A1
- . [Date?]. Formats and procedures for use in data processing systems of the McLean Paleontological Laboratory. McLean Paleontol. Lab., Alexandria, Va. (unpublished offprint). D1, 3
- ARGUS, G. W., and J. W. SHEARD. 1972. Two simple labeling and data retrieval systems for herbaria. *Can. J. Bot.* 50: 2197-2209. D1, 3
- ARNETT, R. H., Jr. 1969a. Storage and retrieval of information from insect specimens. *Entomol. News* 80: 197-205. D3
- . 1969b. Data documents: a new publication plan for systematic entomology. *Entomol. News* 81: 1-11. C1, 3, 4
- . 1970a. Data document numbers. *Entomol. News* 81: 50. C3
- . 1970b. Data document comments. *Entomol. News*. 81: 125-126; 208-209. A1, 3
- . 1970c. Objectives of a taxonomic catalog of Coleoptera. *Coleopterists' Bull.* 24: 76-84. D6
- . 1970d. Entomological Information Storage and Retrieval. Bio-Rand Foundation, Inc., Baltimore, Md. xiii + 209 pp., illus. A1, 3
- . 1971. Guide for writing descriptors. *Entomol. News* 82: 26-27. C2
- . 1972. Data documents for systematic entomology (DDSE). *Entomol. News* 83: 48. A1
- ATMAR, J. W., J. L. POOLER, F. C. WEBB, G. M. FLACHS, and J. J. ELLINGTON. 1973. Construction of a device to identify and count insects automatically. *Environmental Entomol.* 2: 713-716, illus. D4, 5
- ATZ, J. W. 1968. *Dean Bibliography of Fishes*. Am. Mus. Nat. Hist., New York, N.Y., 512 pp. A2
- BACHMANN, B. J., E. A. ADELBERG, and R. BAKEMAN. 1973. SAM: The "Search and Match" computer program of the *Escherichia coli* genetic stock center. *BioScience* 23: 35-36. D1, 2
- BAKER, D. B. 1970. Communication or chaos? *Science* 169: 739-742. A1, 2; C1
- BAKER, D. B., P. V. PARKINS, and J. POYEN. 1972. The future of access (abstracting and indexing) services, pp. 142-166 in A. I. Chernyi [ed.], *Problems of Information Science*. All-Union Inst. for Sci. Tech. Info. A1
- BAKER, H. A. 1970. A key for the genus *Erica* L. using edge-punched cards. *J. So. African Bot.* 36: 151-156. D5, E1
- BALDWIN, P. H., and D. E. OEHLERTS. 1964. The status of ornithological literature. *In Studies in Biological Literature and Communications* 4: 1-53. B2
- BAMFORD, H. E., JR. 1972. A concept for applying computer technology to the publication of scientific journals. *J. Wash. Acad. Sci.* 62: 306-314. B1, C1
- BARTELS, W., M. L. KIENLE, W. LAUX, M. MICATEK, W. STEINHAUSEN, B. STRECKER, and G. WEILAND. 1973. Abstracting periodicals and bibliographies in the field of phytomedicine [in German]. *Pflkrankh.* 8: 449-465. C4
- BASCOMB, S., S. P. LAPAGE, M. A. CURTIS, and W. R. WILLCOX. 1973. Identification of bacteria by computer: Identification of reference strains. *J. Gen. Microbiol.* 77: 291-315. D5
- BAUM, B. R., and B. K. THOMPSON. 1970. Registers with pedigree charts for cultivars: their importance, their contents, and their preparation by computer. *Taxon* 19: 762-768. D1
- BEAMAN, J. H. [ed.]. 1971. Some applications for the taxonomic data matrix: six term papers by students at Michigan State University. 103 p. Sept. D1, 3
- BEAN, J. L. 1969. An automatic data processing system for the documentation of forest-insect survey information. *J. Econ. Entomol.* 63: 1181-1184. C2, D1
- BECKLUND, W. W. 1969. The Index-Catalogue of Medical and Veterinary Zoology at the Beltsville Parasitological Laboratory. *J. Parasitol.* 55: 381-384. C4
- BEJUKI, WALTER M. 1965. Symposium on information science. VI. Form and utilization of bacteriological information in a select docu-

- ment collection. *Bacteriol. Rev.* 29: 546-553. A2
- BERRY, W. B. N. 1970. A local system of automated paleontologic data retrieval and its potential contribution to an eventual nationwide system. *Paleontol.* 44: 527-535. D1, 3
- BESCHEL, R. E., and J. H. SOPER. 1970. The automation and standardization of certain herbarium procedures. *Can. J. Bot.* 48: 547-554. D3
- BIOSIS (BioSciences Information Services of Biological Abstracts). An editorial near the front of every issue of *Biological Abstracts* discusses an information-handling subject of current interest and concern.
- BIOSIS. 1965. Conference on Communications for Biology. Cherry Hill, New Jersey, Nov. 22-23, 1965. 11 pp., mimeo. A1
- . 1970. BioSciences information service—a concept plan (draft). BIOSIS, pp. 1-9 (+11 appendices), mimeo. A1, 2; C1, 2, 4
- . 1973. A guide to the vocabulary of biological literature. BIOSIS, viii + 126 pp. C2
- BONHAM, C. D. 1972. The ecological inventory information-storage-retrieval system for the research ranch, Elgin, Arizona. *Range Sci. Dept. Series, No. 14*, Colo. State Univ., pp 1-93. D1
- BOTTLE, R. T., and H. V. WYATT. 1967. *The Use of Biological Literature*. Archon Books, Hamden, Conn. A3
- BOUGHEY, A. S., K. W. BRIDGES, and A. G. IKEDA. 1968. An automated biological identification key. *Univ. Calif. (Irvine) Mus. Syst. Biol. Res. Ser.* 2: 1-36. D5
- BRENAN, J. P. M. 1974. International conference on the use of electronic data processing in major European plant taxonomic collections. *Taxon* 23: 101-107. D1, 3
- BRIDGES, K. W. 1970. Automatic indexing of personal bibliographies. *BioScience* 20: 93-97. E2
- BRIGHAM, W. V. 1974. Journal coverage by North American fishery biologists. *Trans. Amer. Fish. Soc.* 103: 387-389. B2
- BRILL, R. C. 1971. The TAXIR primer. *Occas. Pap. Inst. Arctic Alpine Res., Univ. Colo.* 1: 1-72. D1
- BRINDLEY, W. A., and R. G. JONES. 1969. A simple, inclusive, and versatile card filing system. *J. Wash. Acad. Sci.* 59: 95-106. E1
- BRODO, I. M. 1971. Publication: the need for responsibility (editorial). *Int. Lichenol. Newsl.* 5(2): 1-5. A1, B1, C1
- BROWN, C. E. 1964. A machine method for mapping insect survey records. *Forestry Chron.* 40: 445-449. D4
- BROWN, C. H. 1956. Most frequently cited serials: entomology. *Sci. Serials. ACRL monogr.* No. 16. Assoc. College & Ref. Libraries, Chicago. 189 pp. B2
- BROWN, W. L. 1961. An international taxonomic register: Preliminary proposals. *Syst. Zool.* 10: 80-85. B1
- BROWN, W. S., J. R. PIERCE, and J. F. TRAUB. 1967. The future of scientific journals. *Science* 158: 1153-1159. B1, C1
- BRYAN, J. H. D. 1966. A multi-purpose information retrieval system based on edge-notched cards. *BioScience* 16: 402-407. E1
- BRYGOO, P. R. 1965. Symposium on information science. I. International aspects of information in microbiology. *Bacteriol. Rev.* 29: 506-515. B2
- BULLIS, H. R., JR., and R. B. ROE. 1967. A bionumeric code application in handling complex and massive faunal data. *Syst. Zool.* 16: 52-55. D7
- BURTON, H. D. 1969. FAMULUS: A computer-based system for augmenting personal documentation efforts. *USDA For. Serv. Res. Note PSW-193*, Berkeley, CA. 6 pp. A2, D2, E2
- . 1973. Personal information systems implications for libraries. *Spec. Libr. pp.* 7-11. E2
- BYER, M. D., J. E. CANTLON, and C. M. WETMORE. 1959. A punch card technique for studying species and species-environment associations. *Ecology* 40: 323-324. E1
- CHENHALL, R. G. 1972. Museum data bank study group. Report of meeting at Hershey, Pa. Mar. 27-28, 1972. *Mus. and Univ. Data, Program and Information Exch., Smithsonian Inst.* 24: 3-5. D2
- . 1973. Sharing the wealth. *Museum News* 51: 21-23. D6
- . 1974. Museums, catalogs and computer nets. *Educom (Fall issue)* 9(2): 7-11. D3, 6
- . 1975. Museum Cataloging in the Computer Age. *Amer. Assoc. State & Local Hist., Nashville.* 256 pp. & 118 figs., 13 tables. D1, 2, 3, 6
- COBSI (Council on Biological Sciences Information). 1970. (see Steere, W. C., 1970).
- CONRAD, G. M. 1965. Symposium on information science, Part III. Changing patterns of scientific periodical publication. *Bacteriol. Rev.* 29: 523-533. D1, 2
- CREIGHTON, R. A., and J. J. CROCKETT. 1971. SELGEM: a system for collection management. *Smithsonian Inst. Info. Syst. Innovations* 2(3): 1-27. D2, 3
- CREIGHTON, R. A., and R. KING. 1969a. The Smithsonian Institution's information retrieval (SIIR) system for biological and petrographic data, pp. 31-50, *in* Schultz, L. [ed.], *The Information Bazaar*. Sixth Ann. Nat. Colloq. Inf. Retr., Coll. Physicians Phila., xi + 492 pp. D3
- CREIGHTON, R. A., and R. KING. 1969b. The Smithsonian Institution Information Retrieval (SIIR) System for Biological and Petrological Data. *Smithsonian Institution Systems Innovations* 1(1): 1-25. D1, 2

- CREIGHTON, R. A., and P. PACKARD. 1974. Computer-assisted information management: Getting oriented. *Info. Syst. Div., Smithsonian Inst., Proc. in Comp. Sci.* 1(2): 1-1-1-18. D1, 2, 3
- CREIGHTON, R. A., P. PACKARD, and H. LINN. 1972. SELGEM retrieval: a general description. *Smithsonian. Inst. Proc. Comp. Sci.* 1: 1-38. D2
- CROVELLO, T. J. 1967. Problems in the use of electronic data processing in biological collections. *Taxon* 16: 481-494. D3
- . 1972a. Computerization of specimen data from the Edward Lee Greene Herbarium. (ND-G) at Notre Dame. *Brittonia* 24: 131-141. D1, 3
- . 1972b. Modabund—the computerized mosquito data bank at University of Notre Dame. *Mosq. News* 32: 548-554. C4
- . 1972c. The plant collecting itineraries of Edward Lee Greene as recreated by computer. *Am. J. Bot.* 59: 674. D1
- CROVELLO, T. J., and R. D. MACDONALD. 1970. Index of EDP-IR projects in systematics. *Taxon* 19: 63-76. C1, D1
- CROVELLO, T. J., S. G. SHETLER, and H. R. MEADOW. 1970. Standards for recording specimen label data for electronic data processing. *Amer. J. Bot.* 57: 752. D3
- CUTBILL, J. L. 1971. New methods for handling biological information. *Biol. J. Linn. Soc.* 3: 253-260. D1, 2
- CUTBILL, J. L., A. J. HALLAN, and G. D. LEWIS. 1971. A format for the machine exchange of museum data, pp. 255-274, in Cutbill, J. L. [ed.], *Data Processing in Biology and Geology*, Academic Press, N. Y. 346 pp. D1, 3
- CUTBILL, J. L., and D. B. WILLIAMS. 1971. A program package for experimental data banking, pp. 107-113, in Cutbill, J. L. [ed.], *Data Processing in Biology and Geology*, Academic Press, N.Y., 346 pp. D1, 3
- DADD, M. N. 1971. The *Zoological Record*—current developments. *Biol. J. Linn. Soc.* 3: 291-294. C4
- DALLWITZ, M. J. 1974. A flexible computer program for generating identification keys. *Syst. Zool.* 23: 50-57. D5
- DAVIS, D. E. 1973. Select your own reading. *BioScience* 23(6): 373. B1
- DENMARK, H. A., H. V. WEEMS, and C. TAYLOR. 1958. Taxonomic codification of biological entities. *Science* 128: 990-992. D7
- DIMOND, J. B. 1970. The periodical literature used by entomologists. *Bull. Entomol. Soc. Canada* 2: 110-112. B2
- DUKE, J. A. 1969. On tropical tree seedlings. *Ann. Missouri Bot. Garden* 56(2): 125-161. D5, E1
- DWINELL, L. D. 1970. Electronic information retrieval. *Phytopath. News* 4: 2-5, 7. C4
- EDWARDS, P. I. 1971a. The general pattern of biological information. *Biol. J. Linn. Soc.* 3: 169-172. C1
- . 1971b. List of abstracting and indexing services in pure and applied biology. *Biol. J. Linn. Soc.* 3: 277-286. C4
- . 1971c. Information and data centres in the biological sciences. *Biol. J. Linn. Soc.* 3: 249-251. C4
- EGGINS, H. O. W. 1971. The Biodeterioration Information Centre: specialized information centre. *Biol. J. Linn. Soc.* 3: 245-248. C4
- EGLE, K. 1973. The heterogeneous problems of evaluation and compilation of data in the biological sciences. *Proc. Third Internat. CODATA Conf.*, pp. 34-36. A1, 2; D1
- EICHHORN, M. M., and R. D. REINECKE. 1970. *Vision Information Center: a user-oriented data base*. *Science* 169: 29-31. C4
- EVANS, I. S. 1971. The implementation of an automated cartography system, pp. 39-55, in Cutbill, J. L. [ed.], *Data Processing in Biology and Geology*, Academic Press, N.Y., 366 pp. D4
- FAVORITE, F. G. 1964. Interim solutions to the biosciences communications problem. *BioScience* 14: 18-20. A1
- FOOTE, R. H. 1967. Entomology looks at its mission—Information storage and retrieval for entomology. *Bull. Entomol. Soc. Amer.* 13: 99-104. A1, 2; B1; C1
- . 1969. Recent advances in bioscience information—entomology's role. *Bull. Entomol. Soc. Amer.* 15: 233-234. A2
- . 1970. New directions for commitment. *J. Wash. Acad. Sci.* 60: 136-140. A1
- . 1972a. American Institute of Biological Sciences: Task Force on Communication and Information Services in Biology. *J. Amer. Soc. Info. Sci.* 23: 280-281. A2
- . 1972b. Communication in the biological sciences, pp. 376-396, in Behnke, J. A. [ed.], *Challenging Biological Problems (AIBS 25th Anniversary Volume)*, Oxford Univ. Press, N.Y. 502 pp., illus. A1
- FOOTE, R. H., and G. M. HAMMACK. 1969. A system-designed entomological data center—a feasibility study. Phase I, Final report. *Biol. Sci. Commun. Proj.-Entomol. Soc. Amer.*, 134 p., 32 tables (NTIS #PB 186-470). (See Graham and Foote 1971 for report of Phase II.). A1, 2; B2; C1
- FOWLER, J. A. 1965. An information retrieval system for biological researchers. *BioScience* 15: 413-417. A2
- FREEMAN, M. E., and D. F. HERSEY. 1963. Keeping up with current research: Science Information Exchange. *Science* 141: 119. C4

- FURLLOW, J. J., L. E. MORSE, and J. H. BEAMAN. 1971. Computers in biological systematics, a new university course. *Taxon* 20: 283-290. D1
- GARFIELD, E. 1964. "Science Citation Index"—a new dimension in indexing. *Science* 144: 649-654. B1; C2, 4
- GASSER, W., AND K. M. GEHRT. 1971. A computer program for identifying microorganisms. *BioScience* 21: 1044-1045. D5
- GATES, D. M. 1971. *Flora North America: A data bank for systematic biology* [editorial]. *BioScience* 21: 507. A2
- GERMERAAD, J. H., and J. MULLER. 1970. A computer-based numerical coding system for the description of pollen grains and spores. *Paleobot. Palynol.* 10: 175-202. D5
- GOMEZ-POMPA, A., and L. I. NEVLING. 1973. The use of electronic data processing methods in the Flora of Veracruz program. *Contrib. Gray Herb.* 203: 49-64. D1, 3
- GOODALL, D. W. 1968. Identification by computer. *BioScience* 18: 485-488. D5
- GORDON, R. E. 1969. Toward an information system for biology-community activity. *BioScience* 19: 628-629. A1
- . 1972. Words of one syllable—what is their meaning? *Counc. Biol. Ed. Newsl.*, July, pp. 5-7. C1
- GORHAM, E. 1968. Journal coverage in the field of limnology. *Limnol. Oceanogr.* 13: 366-369. B2
- GOULD, S. 1954. Permanent numbers to supplement the binomial system of nomenclature. *Am. Sci.* 42: 269-274. D7
- . 1958. Punched cards, binomial names and numbers. *Amer. J. Botany* 45: 331-339. E1
- . 1968. *Geo-Code*, Vols. 1 & 2. The Gould Fund, New Haven, Conn. 262 pp. D4
- GRAHAM, J., and R. H. FOOTE. 1971. A system-designed entomological information center—a feasibility study. Phase II, Final Report. *Entomol. Soc. Amer.*; Vol. 1, 300 p. (NTIS No. PB 204937); Vol. 2 (appendices), 500 p. (See Foote & Hammack 1969 for report of Phase I.). A2
- GREENE, D. M. 1972. A taxonomic data bank and retrieval system for a small herbarium. *Taxon*: 21: 621-629. D1, 3
- GRINER, L. A. 1968. Pathology data retrieval system adopted at a zoological garden. *J. Amer. Vet. Med. Assoc.* 153: 885-892. D1
- GURTOWSKY, C. G. 1968. Preliminary report to the Council of Biological Sciences Information on the preparation of a core list of the substantive primary periodicals in the biological sciences. FASEB, Bethesda, Md. 7 pp., appendices. B2
- . 1970. Selected current primary serial publications in the biological sciences. *Counc. Biol. Sci. Info.*, Rept. COBSI-WD-1, FASEB, Bethesda, Md., 41 pp. (PB-192 945) B2
- GYLLENBERG, H. G. 1965. A model for computer identification of micro-organisms. *J. Gen. Microbiol.* 39: 401-405. D5
- HAGLIND, J. B., H. J. ACKERMANN, R. E. MAIZELL, T. M. MANNING, and B. S. SCHLESSINGER. 1969. Storage and retrieval of agricultural screening data. *J. Chem. Doc.* 9: 37-39. D1, 2
- HAHN, P. 1973. Guide to the Literature for the Industrial Microbiologist. IFI/Plenum, New York, 206 pp. B2
- HALE, M. E., and R. CREIGHTON. 1970. An automated system for recording exchanges. *FNA Report No. 32*: 1-9. D1
- HALL, A. V. 1970. A computer-based system for forming identification keys. *Taxon* 19(1): 12-18. D5
- . 1972a. Computer-based data banking for taxonomic collections. *Taxon* 21: 13-25. D3
- . 1972b. The use of a data-banking system for taxonomic collections. *Contrib. Bolus Herb.* 5: 1-78. D3
- . 1973. The use of a computer based system of aids to classification. *Contrib. Bolus Herb.* [Univ. Cape Town], No. 6, 110 p. D5
- . 1974. Museum specimen record data storage and retrieval. *Taxon* 23: 23-28. D3
- HAMMACK, G. M. 1970a. Entomological Society of America Information Directory. *Biol. Sci. Commun. Proj.*, Washington, D.C., pp. 1-50. C4
- . 1970b. The serial literature of entomology—a descriptive study. *Entomol. Soc. Amer.*, College Park, Md., 85 pp. B2
- HATTERY, LOWELL H. 1961. Information and communication in biological science. The American University, Washington, D.C., 99 pp. A1
- HAWKES, J. G., B. L. KERSHAW, and R. C. READETT. 1968. Computer mapping of species distributions in a county flora. *Watsonia* 6: 350-364. D4
- HEATH, J. 1970. Provisional atlas of the insects of the British Isles. Part 1, Lepidoptera Rhopalocera, Butterflies. *Biol. Rec. Center, Huntingdonshire, England*, Maps 1-57. D4
- . 1971a. The European invertebrate survey. *Acta Entomol. Fenn.* 28: 27-29. D3, 4
- . 1971b. Instructions for recorders. Biological Records Centre, Huntingdonshire, Engl., 23 pp., cards. D3, 4
- HEPTING, G. H. 1964. Codes to the Intredis Register System for literature retrieval in forest pathology. FAO-IUFRO Symposium on Internationally Dangerous Forest Diseases & Insects, Oxford, Engl., 61 pp. C2
- . 1967. International Tree Disease Register. *Agr. Sci. Rev.* 5: 33-34. C4

- HERMAN, C. M. 1973. The Council of Biology Editors—its contribution to biological communication. *BioScience* 23: 177–178. A1
- HEUMANN, KARL F. [ed.]. 1974. Biomedical literature and information services. *Fed. Proc.* 33: 1693–1723 (a collection of 10 papers, many of which will be helpful to the non-medical biologist). A1, 2; B2; C4
- HUDSON, L. W., R. D. DUTTON, M. M. REYNOLDS, and W. E. WALDE. 1971. TAXIR—a biologically oriented information retrieval system as an aid to plant introduction. *Econ. Bot.* 25: 401–406. D1, 2
- HULL, D. L. 1966. Phylogenetic nomenclature. *Syst. Zool.* 15: 14–17. D7
- HULL, N. C., J. J. BENUCHAMP, and D. E. REICHLER. 1970. Pitfall 1: A general-purpose data processing program for environmental data. Oak Ridge Nat. Lab., IBP-70-2, 67 pp. D1, 2
- International Council of Scientific Unions Abstracting Board (ICSU-AB). 1967. Some characteristics of primary periodicals in the domain of the biological sciences. ICSU-AB, Paris, France, 79 p. B2
- IRWIN, H. S. 1973. Flora North America: Austerity casualty? *BioScience* 23: 215. A2, D1
- JACOBUS, D. P., R. R. GULICK, L. SCHULTZ, and P. V. PARKINS. 1966. Direct user access to the biological literature through abstracts: A cooperative experiment in customized service. *BioScience* 16: 599–603. C4
- JAHN, T. L. 1961. Man versus machine: A future problem in protozoan taxonomy. *Syst. Zool.* 10: 179–192. D7
- JAMESON, D. L. 1969. Information retrieval for the working scientist: a simple algorithm. *BioScience* 19: 231–234. C4
- JOHNSON, M. W., B. SNOAD, and D. R. DAVIES. 1971. A computer based record system for *Pisum*. *Euphytica* 20: 126–130. D3
- KELLER, C., and T. J. CROVELLO. 1974. Procedures and problems in the incorporation of data from floras into a computerized data bank. *Indiana Acad. Sci.* (1974): 116–122. D1
- KENDRICK, W. B. 1964. Toward better information storage and retrieval. *Mycologia* 56: 781–782. A1
- . 1972. Computer graphics in fungal identification. *Canad. J. Bot.* 50: 2171–2176. D5
- KENNEDY, H. E. 1972. Progress Report: BIOSIS/CAS/Ei overlap study. *Bio. Abstr.* 53(9): xxiv. C4
- KENNEDY, H. E., and P. V. PARKINS. 1969. Biological literature, pp. 537–551, in *Encyclopedia of Library and Information Science*, Vol. 2, Marcel Dekker, New York. B1; C1, 4
- KIEHL, E. R. 1970. An information network for the agricultural sciences. *Agr. Sci. Rev.* 8: 11–15, 46. A2
- KING, W. B., G. E. WATSON, and P. J. GOULD. 1967. An application of automatic data processing to the study of seabirds, I. Numerical coding. *Proc. U. S. Nat. Mus.* 123(3609): 1–29. D3, 7
- KOGAN, M., and W. H. LUCKMANN. 1971. A comprehensive program of research and information on soybean insects. *Bul. Entomol. Soc. Amer.* 17: 92–93. C4, D1
- KRAUSS, H. M. 1973a. The use of generalized information processing systems in the biological sciences. *Taxon* 22: 3–18. D1, 2
- . 1973b. The information system design for the Flora North America Program. *Brittonia* 25: 119–134. A2, D1
- KROMBEIN, K. V., J. F. MELLO, and J. J. CROCKETT. 1974. The North American Hymenoptera Catalog: A pioneering effort in computerized publication. *Bull. Entomol. Soc. Amer.* 20: 24–29. D6
- KULL, F. C. 1965. Symposium on Information Science. IV. Publication trends in microbiology. *Bacteriol. Reviews* 29: 534–543. B2
- LAMANNA, C. 1970. In favor of publish or perish. *J. Wash. Acad. Sci.* 60: 129–135. B1
- LANDRUM, B. J. 1969. An operational data processing system for natural history specimens. *Antarctic J.* 4: 278–284. D3
- LAPAGE, S. P., S. BASCOMB, W. R. WILCOX, and M. A. CURTIS. 1973. Identification of bacteria by computer: General aspects and perspectives. *J. Gen. Microbiol.* 77: 273–290. D5
- LAUX, W. 1972. On the information activity of the Documentation Center for Plant Protection in the field of entomology (in German). *Z. Angew. Entomol.* 70(3): 281–285. C4
- LC, NRC (Library of Congress, National Referral Center). 1972. A Directory of Information Sources in the United States: Biological Sciences. *Libr. Congr.* 577 pp. C4
- LENTZ, P. L. 1969. Information management in mycology. *Plant Sci. Bull.* 15(3): 3–5. B2, C4
- LEVINE, N. D. 1955. A punched card system for filing parasitological bibliography cards. *J. Parasitol.* 41: 343–352. E1
- LEWIN, R. A. 1971. Plethora of phycology journals. *Science* 173: 981. B1
- LEWIS, G. D. 1965. Obtaining information from museum collections and thoughts on a national museum index. *Museums J.* 65: 12–22. D1
- . 1967. Information retrieval for museums. *Museums J.* 67: 88–120. D3
- LIETH, H., and J. S. RADFORD. 1971. Phenology, resource management, and synagraphic computer mapping. *BioScience* 21: 62–70. D4
- LITTLE, F. J., Jr. 1964. The need for a uniform system of biological nomenclature. *Syst. Zool.* 13: 191–194. D7

- LLOYD, J. E. 1969. A paper "computer" for entomologists with limited recall. *Entomol. News* 80: 205–206. E1
- LLOYD, P. S., V. MOFFETT, and D. W. WINDLE. 1972. Computer storage and retrieval of botanical survey data. *J. Appl. Ecol.* 9: 1–11. D1, 4
- MACDONALD, R. D. 1966a. The application of electronic data processing methods to botanical garden and arboretum records. *N. Y. Bot. Garden J.* 16(6): 246. D1
- . 1966b. Electronic data processing methods for botanical garden and arboretum records. *Taxon* 15: 291–295. D1
- . 1971. The Plant Records Centre of the American Horticultural Society. The Arboretum and Botanic Garden 5. D1, 3
- MACDONALD, R. D., M. F. OLSON, and M. E. MACDONALD. 1967. The International Plant Records Center Pilot Project—Preliminary Report. *Arboretum and Botanical Garden Bull.* 1(3): 28–32. D1
- MACDONALD, R. D., and M. REED. 1968. The International Plant Records Center Pilot Project—progress and future. *Arboretum & Botanical Garden Bull.* 1(1): 29–35. D1
- MANNING, R. B. 1969a. Automation in museum collections. *Proc. Biol. Soc. Wash.* 82: 671–686. D1, 3, 4, 7
- . 1969b. A computer-generated catalog of types: A byproduct of data processing in museums. *Curator* 12: 134–138. D6
- MCALLISTER, D. E., A. B. LEERE, and S. P. SHARMA. 1972. A batch process computer information retrieval and cataloging system in the fish collection, National Museum of Natural Sciences. *Syllogeus* 1: 1–20. D1, 3
- MEADOW, H. R. 1970. The FNA System Concept II. *Flora North America Report* 55: 1–15. D1
- MEIKLE, R. D. 1971. The history of the *Index Kewensis*. *Biol. J. Linn. Soc.* 3: 295–299. D3, 6
- MELLO, J. F. 1969. Paleontologic data storage and retrieval. *Proc. N. Amer. Paleontol. Conv.*; Sept., Pt. B: 57–71. B2
- . 1974. Computer revolution in systematics. *Taxon* 23: 21–22. A1
- MELLO, J. F., and F. J. COLLIER. 1972. New procedures in recording specimen-related data on fossils. *J. Paleontol.* 46: 776–777. D3
- MICHENER, C. D. 1963. Some future developments in taxonomy. *Syst. Zool.* 12: 151–172. D7
- MOHLER, I. C. 1969. The impact of information science on biology; a possible society role. *J. Wash. Acad. Sci.* 59: 117–120. A2, C4
- . 1970. A profile of the Biological Sciences Communications Project. *J. Wash. Acad. Sci.* 60: 15–17. A2
- . 1972. The future of publication: Implications for microbiologists. *ASM News* 38: 285–287. B1
- MORGANS, J. F. C. 1965a. A punched card indexing system to literature for the biological research worker or institution. *Tuatara* 13: 77–89. C1, E1
- . 1965b. A simple and flexible catalog of systems for biological collections, large and small. *Tuatara* 13: 116–121. D1
- MORSE, L. E. 1968. Construction of identification keys by computer. *Amer. J. Bot.* 55: 737 (abstr.) D5
- . 1969. Time-sharing computers as aids to identification of plant specimens. XI Int. Bot. Congr., Abstracts, p. 152. D5
- . 1971. Specimen identification and key construction with time-sharing computers. *Taxon* 20: 269–282. D5
- . 1974a. Computer-assisted storage and retrieval of the data of taxonomy and systematics. *Taxon* 23: 29–43. D1, 3
- . 1974b. Computer programs for specimen identification, key construction and description printing using taxonomic data matrices. *Biol. Series, Vol. 5, No. 1, Pubs. of the Museum, Michigan State Univ., E. Lansing.* 128 pp. D5
- MORSE, L. E., J. H. BEAMAN, and S. G. SHETLER. 1968. A computer system for editing diagnostic keys for Flora North America. *Taxon* 17: 479–483. D5
- MORSE, L. E., J. J. FURLOW, and J. H. BEAMAN. 1971. Computers in systematic biology: A course syllabus. FNA Secretariat, Smithsonian Inst., Washington, D.C. FNA Rept. No. 62: 1–68. A3
- MORSE, L. E., J. A. PETERS, and P. B. HAMEL. 1971. A general data format for summarizing taxonomic information. *BioScience* 21: 174–180. D5
- MUDPIE (Museum and University Data, Program and Information Exchange). See Peters, J. A. [ed.], 1967–1972.
- MULLINS, L. J., and W. J. NICKERSON. 1951. A proposal for serial number identification of biological species. *Chron. Bot.* 12: 4, 211–215. D7
- NAMKOONG, G., and J. GRAHAM. 1970. A machine storage and retrieval system for personal files of scientific literature. *Bull. Entomol. Soc. Amer.* 16: 193; *BioScience* 20: 994. C4
- NATIONAL ACADEMY OF SCIENCES. 1970. Communication in the life sciences [chapter 8], pp. 405–426, in *The Life Sciences. Committee on Research in the Life Sciences of the Committee on Sciences and Public Policy, NAS*, 526 pp. A1, B1, C1, D1
- NORRIS, J. R. 1971. Information sources and literature searching in biological control. Ap-

- pendix 2, pp. 717-720, in H. D. Burges & N. W. Hassey [eds.], *Microbiological Control of Insects and Mites*. Academic Press, N. Y. xxii + 861 pp. B2, C4
- NOYCE, D. E. 1965. Listing plant names and namers. *Frontiers of Plant Science; Nov.*, pp. 4-5. D1
- PACKER, J. S., and W. P. MURDOCH. 1974. Publication of scientific papers in the journals of the Entomological Society of America—an 11-year review. *Bull. Entomol. Soc. Amer.* 20: 249-253. B2
- PANKHURST, R. J. 1970a. Key generation by computer. *Nature* 227: 1269-70. D5
- . 1970b. A computer program for generating diagnostic keys. *Computer J.* 13: 145-151. D2, 5
- . 1971. Botanical keys generated by computer. *Watsonia* 8: 357-368. D5
- . 1974. Automated identification in systematics. *Taxon* 23: 45-51. D5
- PANKHURST, R. J., and S. M. WALTERS. 1971. Generation of keys by computer, pp. 189-203, in Cutbill, J. L. [ed.], *Data Processing in Biology and Geology*, Academic Press, N.Y., 346 pp. D5
- PATRIAS, K. J. 1970. Analysis of Secondary Serial Literature Publications of Interest to Entomologists. *Bio. Sci. Commun. Proj.*, Washington, D.C., pp. 1-151. C4
- PARKINS, P. V. 1966. BioSciences Information Service of Biological Abstracts. *Science* 152: 889-894. C4
- . 1969. BioSciences Information Service of Biological Abstracts, in *Encyclopedia of Library and Information Science*, Vol. 2, pp. 603-621. Marcel Dekker, Inc., N. Y. C4
- . 1970. Moving toward a world system for abstracting and indexing services. *Biol. Abstr.*, Vol. 51. (editorial). C4
- . 1971. Allies in the transfer of scientific information. *Biol. Abst.* 52(1) Jan. 1 (unnumbered page). B1, C1
- . 1974. Science information services in an environment of change (1973 Miles Conrad Memorial Lecture). *Nat. Fed. Abstr. Indexing Serv. Rept.* No. 7, 30 pp. C1, 4
- PARKINS, P. V., and H. E. KENNEDY. 1971. Secondary information services, pp. 247-275, in Cuadra, C. A., and A. W. Luke [eds.], *Ann. Rev. Inf. Sci.*, Vol. 6. *Enycl. Britannica*, Inc., N.Y., 524 pp. A1, C1
- PARRISH, D. W., J. D. DECOURSEY, and J. M. GEARY. 1966. Present and future concepts in the gathering of entomological information. *Bull. Entomol. Soc. Amer.* 12: 128-129. C4
- PERDUE, R. E., Jr. 1964. Coping with information relevant to the utilization of plants. *Economic Botany* 18: 366-377. E1
- PERRING, F. H. 1963. Data processing for the Atlas of the British Flora. *Taxon* 12(5): 183-190. D3, 4
- . 1967. The processing of biological data. *Inst. Biol. J.* 14: 17-19. D3, 4
- . 1971a. The Biological Records Centre—a data centre. *Biol. J. Linn. Soc.* 3: 237-243. D3, 4
- . 1971b. The British biological recording network, pp. 115-121, in Cutbill, J. L. [ed.], *Data Processing in Biology and Geology*, Academic Press, N.Y., 346 pp. D1, 4
- PETERS, J. A. [ed.] 1967-1972. *Museum and University Data*, Nos. 1-26. Division of Program and Information Exchange (MUDPIE), Reptiles and Amphibians, Nat. Mus. of Nat. Hist., Smithsonian Institution, Washington, D.C. This informative newsletter discusses a wide range of information handling material of interest to biologists. Its publication ceased with the untimely death of its widely respected editor.
- . 1970. The computer and the collection-at-large. *Curator* 13: 263-266. D1
- PIACESI, D., Jr., and R. A. CREIGHTON. 1969. An approach to the geography problem in museums, pp. 441-456, in Schultz, L. [ed.], *The Information Bazaar*. Sixth Ann. Nat. Colloq. Inf. Retr., Coll. Physicians Phila., xi + 492 pp. D4
- PORTER, J. R. 1967. The scientific journal—300th anniversary. *Bacteriol. Rev.* 28: 211-230. B1
- RABEL, G. 1940. A decimal system for organisms. *Discovery (N.S.)* 3: 13-69. D7
- RADFORD, G. L., and R. J. PANKHURST. 1973. A conservation data base. *New Phytol.* 72: 1191-1206. D1
- RANDAL, J. M., and G. H. SCOTT. 1967. Linnean nomenclature: An aid to data processing. *Syst. Zool.* 16: 278-281. B1, D1
- REDDIN, M. C., and E. H. FEINBERG. 1973. The core literature of biology, its sponsorship and national origin. *BioScience* 23: 354-357. D1, 2
- REED, M. J., W. R. POWELL, and B. S. BAL. 1963. Electronic data processing codes for California wildland plants. *Pac. S. W. For. & Range Exp. Sta.*, U.S. Forest Serv. Res. Note PSW-N20, 6p. + pocket guide. D3, 4, 7
- REICHL, E. R. 1963. Eine ideale Literaturkartei. *Wien. Entomol. Gesell. Z.* 48: 177-183. E1
- REINECKE, J. P. 1967. Information retrieval and film filing system for biological research. *Texas Repts. Biol. Med.* 25: 334-341. E1
- RENSBERGER, J. M., and W. B. N. BERRY. 1967. An automated system for retrieval of museum data. *Curator* 10: 297-317. D4
- RICKMAN, J. I., A. E. HARVEY, and C. G. SHAW. 1972. SOLAR: An on-line information

- retrieval system for plant pathology. *Agr. Exp. Sta. Bull.* 758 D2
- RIVAS, L. R. 1965. A proposed code system for storage and retrieval of information in systematic zoology. *Syst. Zool.* 14: 131–132. D7
- ROGERS, D. J. 1966. Preliminary description of the information retrieval project from the Taximetrics Laboratory of Colorado State University. 20 pp., mimeo. D1
- ROGERS, D. J., H. S. FLEMING, and G. ESTABROOK. 1967. Use of computers in studies of taxonomy and evolution. *Evol. Biol.* 1: 169–196. D1
- RUSSELL, N. H. 1962. The future impact of information retrieval on biology. *J. Ariz. Acad. Sci.* 2: 55–57. A1
- SATCOM (Committee on Scientific & Technical Communication). 1969. Scientific and Technical Communication, a Pressing National Problem and Recommendations for Its Solution. *Nat. Acad. Sci., Washington, D.C.* xiii + 322 pp. (Also, synopsis of same report, published separately, 30 pp.). A1
- SAVAGE, D. E. 1964. The need for a modern data retrieval system to support the University of California Museum of Paleontology. *U. Calif., Berkeley*, mimeo. D1
- SCHULTZ, L. 1968. New developments in biological abstracting and indexing. *Lib. Trends* 16: 337–352. C2
- . 1974. Breaking the communication barrier between searcher and literature file; an interactive guide. *J. Am. Soc. Info. Sci.* 25: 3–9. C4
- SCRIVENOR, T. V. 1971. The Commonwealth Agricultural Bureaux abstracting and indexing services. *Biol. J. Linn. Soc.* 3: 287–290. C4
- SHENEFELT, R. D. 1969. Storage and retrieval of entomological information as applied to Braconidae. *Bull. Entomol. Soc. Amer.* 15: 246–250. E1
- SHERVIS, L. J., and R. D. SHENEFELT. 1973a. A controlled indexing vocabulary for *Apanteles* species literature. *Bull. Entomol. Soc. Amer.* 19: 147–152. C2
- . 1973b. Poor access to *Apanteles* species literature through titles, abstracts and automatically extracted species names as keywords. *J. Wash. Acad. Sci.* 63: 23–25. C2
- SHERVIS, L. J., R. D. SHENEFELT, and R. H. FOOTE. 1972. Species-level analysis of biological literature for storage and retrieval. *BioScience* 22: 651–655. C1, 2
- SHETLER, S. G. 1971. Flora North America as an information system. *BioScience* 21: 14–18. D1
- . 1973. Information systems and data banking, pp. 469–497, in Radford, A. E. *et al.* Chapel Hill, Univ. No. Carolina Student Stores. A1; D1, 3
- . 1974. Demythologizing biological data banking. *Taxon* 23(1): 71–100. A1; D1, 3
- SHETLER, S. G., J. H. BEAMAN, M. E. HALE, L. E. MORSE, J. J. CROCKETT, and R. A. CREIGHTON. 1969. Pilot data processing systems for floristic information, pp. 275–310, in Cutbill, J. L. [ed.], *Data Processing in Biology and Geology*, Academic Press, N.Y., 346 pp. D1
- SHETLER, S. G., and H. M. KRAUSS. 1971. Flora North America: A comprehensive program of biological research, information systems development and data banking concerned with the vascular plants of North America north of Mexico. 124 pp. & appendices A–I. (Proposal to NSF from the FNA Program Council, S. G. Shetler, Principal Investigator.). FNA Report No. 61. A1, C4, D1
- SHETLER, S. G., M. J. PETRINI, C. G. CARLEY, M. J. HARVEY, L. E. MORSE, T. E. KOPFLER, *et al.* 1973. An introduction to the Botanical Type Specimen Register. *Smithsonian Contr. Bot.* No. 12, 186 p. D1, 3
- SHETLER, S. G., and R. W. READ (eds.). 1973. International index of current research projects in plant systematics, No. 7. *Flora North America Rep. #71*, Dep. Botany, Smithsonian Inst., Washington, D.C. xxii + 118 pp. D1
- SHILLING, C. W., and M. BENTON. 1964. Aquatic biology serials—their location and characteristics. *Bio. Sci. Comm. Proj. Communique*, George Washington Univ., Washington, D.C., 110 pp. B2
- SIMON, H. R. 1970. Analyses of bibliographies on biocontrol. *J. Doc.* 26: 337–339. B2
- SKERMAN, V. B. D. 1973. Statement on the World Federation for Culture Collections Centre for Storage, Retrieval and Classification of Data on Microorganisms. *Internat. J. Syst. Bacteriol.* 23: 477–479. D1
- SMITH, J. R. 1970. The feasibility of a world system: UNISIST by ICSU out of UNESCO. *Aslib Proc.* 22: 395–398. A1, 2
- SMITH, R. C., and W. M. REID. 1972. *Guide to the Literature of the Life Sciences*. 8th Ed. Burgess Pub. Co., 167 pp. B2
- SOPER, J. H. 1964. Mapping the distribution of plants by machine. *Canad. J. Bot.* 42: 1087–1100. D4
- . 1966. Machine-plotting of phytogeographical data. *Can. Geogr.* 10: 15–26. D5
- . 1969. The use of data processing methods in the herbarium. *Anales Inst. Biol. Univ. Nac. México, Ser. Bot.* 40: 105–116. D3
- SOPER, J. H., and F. H. PERRING. 1967. Data processing in the herbarium and museum. *Taxon* 16: 13–19. D3
- SQUIRES, D. F. 1966. Data processing and museum collections: a problem for the present. *Curator* 9: 216–227. D3

- . 1968. Collections and the computer. *BioScience* 18: 973-974. D3
- . 1970. An information storage and retrieval system for biological and geological data. *Curator* 13: 43-61. D1
- . 1971. Implications of data processing for museums, pp. 235-253, in Cutbill, J. L. [ed.], *Data Processing in Biology and Geology*, Academic Press, N.Y., 346 pp. D3
- STEERE, W. C., ed. 1970. *Information Handling in the Life Sciences—Council on Biological Sciences Information*. (COBSI). Div. Biol. Agr., Nat. Res. Council., Feb. 79 pp. A1
- STRAND, R. H., and H. A. FRIBOURG. 1972. A computerized personal bibliographic reference system. *Agron. J.* 64: 845-847. C4, E2
- SUSZYNSKI, N. J. 1971. Recent advances in source data automation, pp. 57-68, in Cutbill, J. L. [ed.], *Data Processing in Biology and Geology*, Academic Press, N.Y., 346 pp. D1, 3
- TAYLOR, R. L. 1971. The Flora North America project. *BioScience* 21: 11-13. D1
- TRAVIS, B. V., H. H. CASWELL, Jr., W. B. ROWAN, H. STARCKE, and C. W. ROSS. 1962. Classification and coding system for compilations from the world literature on insects and other arthropods that affect the health and comfort of man. Quartermaster R&E Ctr., US Army, Tech. Rpt. ES-4, August. C2, E2
- TRAUGER, S. C., R. D. SHENEFELT, and R. H. FOOTE. 1974. Searching entomological literature. *Bull. Entomol. Soc. Amer.* 20: 303-315. B2, C4
- TUNEVALL, G. [ed.]. 1969. *Periodicals Relevant to Microbiology and Immunology—A World List—1968*. Wiley Interscience, New York. B2
- TURNBULL, J. 1967. Current Research Information System—USDA's newest development in information retrieval. *Agric. Sci. Rev.* 5: 30-33. D1
- UNESCO (United Nations Educational, Scientific and Cultural Organization). 1970. Guidelines for the establishment and development of monolingual scientific and technical thesauri for information retrieval. *Sc/MD/20*: 1-14. C2
- VAN GELDER, R. G., and S. ANDERSON. 1967. An information retrieval system for collections of mammals. *Curator* 10: 32-42. D1, E1
- VANCE, D. 1970. Museum data banks. *Info. Storage Retr.* 5: 203-211. D1, 3
- WADE, N. 1972. UNISIST and SIE: Promise and fulfillment in informatics. *Science* 176: 266; 177: 473-474. D1
- WALKER, D., P. MILNE, J. GUPPY, and J. WILLIAMS. 1968. The computer assisted storage and retrieval of pollen morphological data. *Pollen et Spores* 10: 251-262. D1, 3
- WALKER, M. J. 1965. Characteristics of professional scientific journals. *STWP Review* 12: 9-10. B1
- WALSH, J. 1973. Flora North America: Project nipped in the bud. *Science* 179(4075): 778. A2
- WALTERS, S. M. 1963. Botanical nomenclature, punched cards, and machines—a comment. *Taxon* 12: 249-250. D1, E1
- WHITE, K. E., and G. GRODHAUS. 1972. Computer information retrieval system for California mosquito collection records. *Calif. Vector Views* 19: 27-39. D1
- WHITEHEAD, P. J. P. 1971. Storage and retrieval of information in systematic zoology. *Biol. J. Linn. Soc.* 3: 211-220. C4; D1
- WILCOX, F. H. 1968. A simple system for edge-notched cards. *Turttox News* 46: 263-267. E1
- WILLCOX, W. R., S. P. LAPAGE, S. BASCOMB, and M. A. CURTIS. 1973. Identification of bacteria by computer: theory and programming. *J. Gen. Microbiol.* 77: 317-330. D5
- WISE, R. R. 1972. Information Center Profile: Biological Sciences Communication Project (BSCP). *Information—Part 1* 4(5): 299-301. C4
- . 1973. The George Washington University, The Medical Center, Biological Sciences Communication Project. Pp. 371-380, in *Encyclopedia of Library and Information Science*, Vol. 9. A2
- WOLF, V. S. 1966. Titling biological papers for proper storage and retrieval. *Bull. Entomol. Soc. Amer.* 12: 370-373. B1
- WOOD, C. E., Jr., R. S. COWAN, and G. BUCHHEIM. 1963. Botanical nomenclature, punched cards, and machines. *Taxon* 12: 2-12. D1, E1
- WOOD, G. C. 1954. Editorial: The chemical-biological coordination center and entomology. *J. Econ. Ent.* 47: 1-3. D1
- WOOD, J. L., C. FLANAGAN, and H. E. KENNEDY. 1972. Overlap in the lists of journals monitored by BIOSIS, CAS, and EI. *J. Am. Soc. Info. Sci.* 23: 36-38. C1, 4
- . 1973. Overlap among the journal articles selected for coverage by BIOSIS, CAS, and EI. *J. Am. Soc. Info. Sci.* 24: 25-28. C1, 4
- WOODFORD, F. P. 1969. Improving the communication of scientific information. *BioScience* 19: 625-627. A1
- WOOSTER, H. 1970. The future of scientific publishing—or, what will scientists be doing for brownie points? *J. Wash. Acad. Sci.* 60: 41-45. B1
- YERKE, T. B. 1970. Computer support of the researcher's own documentation. *Datamation* (3 unnumbered pages). E2
- . 1971. Information networks for forestry—a key need. *J. Forestry* 69: 565-567. C4; D1

YERKE, T. B., H. BURTON, and R. M. RUSSELL. 1969. FAMULUS: A personal documentation system—user's manual. Pac. N.W. For. & Range Exp. Sta., USDA, Berkeley, CA, 40 pp. (NTIS No. PB-202-534). E2

YOCHELSON, E. L. 1969. Publication, microfilm, microcard, microfiche, and the International Code of Zoological Nomenclature. Syst. Zool. 18: 476–480. B1

ZWEIMER, R. L. 1970. Identification of journal characteristics useful in improving input and output of a retrieval system. Fed. Proc. (FASEB) 29: 1595–1604. B1, C1

References Assigned to Subject Categories

A. General

1. State-of-the-art, problems, need for improvement: Anon. 1974; Arnett 1970b, d, 1972; Baker 1970; Baker *et al.* 1972; BIOSIS 1965, 1970; Brodo 1971; Egle 1973; Favorite 1964; Foote 1967, 1970, 1972b; Foote & Hammack 1969; Heumann 1974; Gordon 1969; Hattery 1961; Herman 1973; Kendrick 1964; Mello 1974; NAS 1970; Parkins & Kennedy 1971; Russell 1962; SATCOM 1969; Shetler 1973, 1974; Shetler & Krauss 1971; Smith 1970; Steere 1970; Woodford 1969.

2. Descriptions of broadly based (organizational) information efforts: Anon. 1954, 1970c, 1972; Atz 1968; Baker 1970; Bejuki 1965; BIOSIS 1970; Burton 1969; Egle 1973; Foote 1967, 1969, 1972a; Foote & Hammack 1969; Fowler 1965; Gates 1971; Graham & Foote 1971; Heumann 1974; Irwin 1973; Kiehl 1970; Krauss 1973b; Mohler 1969, 1970; Smith 1970; Walsh 1973; Wise 1973.

3. General texts: Arnett 1970d; Bottle & Wyatt 1967; Morse, Furlow & Beaman 1971.

B. Primary publications

1. State-of-the-art, problems, need for improvement: Anderson & Van Gelder 1970; Bamford 1972; Brodo 1971; Brown 1961; Brown *et al.* 1967; Conrad 1965; Davis 1973; Foote 1967; Garfield 1964; Kennedy & Parkins 1969; Lamanna 1970; Lewin 1971; Mohler 1972; NAS 1970; Parkins 1971; Porter 1967; Randal & Scott 1967; Walker 1965; Wolf 1966; Wooster 1970; Yochelson, 1969; Zweimer 1970.

2. Surveys of primary publications by discipline, descriptions of core literature: Alvorson 1964; Anderson 1966; Anderson & Van Gelder 1970; Anon. 1967; Baldwin & Oehlerts 1964; Brigham 1974; Brown 1956; Brygoo 1965; Conrad 1965; Dimond 1970; Foote & Hammack 1969; Gorham 1968; Gurtowski 1968, 1970; Hahn 1973; Hammack 1970b; Heumann 1974; ICSU-AB 1967; Kull 1965; Lentz 1969; Mello 1969; Norris 1971;

Packer & Murdoch 1974; Shilling & Benton 1964; Simon 1970; Smith & Reid 1972; Trauger *et al.* 1974; Tunevall 1969.

C. Secondary literature information activities

1. Description of primary-secondary relationships and need for improvement: Anderson & Van Gelder 1970; Arnett 1969b; Baker 1970; Bamford 1972; BIOSIS 1970; Brodo 1971; Brown *et al.* 1967; Crovello & MacDonald 1970; Edwards 1971a; Foote 1967; Foote & Hammack 1967; Gordon 1972; Kennedy & Parkins 1969; Morgans 1965a; NAS 1970; Parkins 1971, 1974; Parkins & Kennedy 1971; Shervis *et al.* 1972; Wood *et al.* 1972, 1973; Zweimer 1970.

2. Cataloging and indexing, including discussions of indexing terms, subject headings, thesauri, etc.: Anderson 1962; Anon 1963; Arnett 1971; Bean 1969; BIOSIS 1970, 1973; Garfield 1964; Herting 1964; Schultz 1968; Shervis & Shenefelt 1973a, b; Shervis *et al.* 1972; Travis *et al.* 1962; UNESCO 1970.

3. Abstracts: Arnett 1969b, 1970a, b.

4. Descriptions of secondary systems, subject matter content, methodology, critiques: Anderson & Van Gelder 1970; Anon. 1972; Arnett 1969b; Bartels *et al.* 1973; Becklund 1969; BIOSIS 1970; Crovello 1972b; Dadd 1971; Dwinell 1970; Edwards 1971b, c; Eggins 1971; Eichhorn & Reinecke 1970; Freeman & Hersey 1963; Garfield 1964; Hammack 1970a; Hepting 1967; Heumann 1974; Jacobus *et al.* 1966; Jameson 1969; Kennedy 1972; Kennedy & Parkins 1969; Kogan & Luckmann 1971; Laux 1972; LC-NRC 1972; Lentz 1969; Mohler 1969; Namkoong & Graham 1970; Norris 1971; Patrias 1970; Parkins 1966, 1969, 1970, 1974; Parrish *et al.* 1966; Schultz 1974; Scrivenor 1971; Shetler & Krauss 1971; Strand & Fribourg 1972; Trauger *et al.* 1974; Whitehead 1971; Wise 1972; Wood *et al.* 1972, 1973; Yerke 1971.

D. Data information systems

1. Descriptions of systems, subject-matter content, methodology, critiques: Addison *et al.* 1969; Addor *et al.*, 1974; Albrecht & Skavanl 1974; Anon. 1954, 1969, 1970a, 1973, [date?]; Argus & Sheard 1972; Bachmann *et al.* 1973; Baum & Thompson 1970; Beaman 1971; Bean 1969; Berry 1970; Bonham 1972; Brenan 1974; Brill 1971; Chenhall 1975; Creighton & King 1969b; Creighton & Packard 1974; Crovello 1972a, c; Crovello & MacDonald 1970; Cutbill 1971; Cutbill *et al.* 1971; Cutbill & Williams 1971; Egel 1973; Furlow *et al.* 1971; Gomez-Pompa & Neveling 1973; Greene 1972; Griner 1968; Hale & Creighton 1970; Haglind *et al.* 1969; Hudson *et al.* 1971; Hull *et al.* 1970; Irwin 1973; Keller & Crovello 1974; Kogan & Luckmann 1971; Krauss 1973a, b; Lewis 1965; Lloyd *et al.* 1972; MacDonald 1966a, b, 1971; MacDonald *et al.* 1967;

MacDonald & Reed 1968; Manning 1969a; McAllister *et al.* 1972; Meadow 1970; Morgans 1965b; Morse 1974a; NAS 1970; Noyce 1965; Perring 1971b; Peters 1970; Radford & Pankhurst 1973; Randal & Scott 1967; Reddin & Feinberg 1973; Rogers 1966; Rogers *et al.* 1967; Savage 1964; Shetler 1971, 1973, 1974; Shetler *et al.* 1969; Shetler & Krauss 1971; Shetler *et al.* 1973; Shetler & Read 1973; Skerman 1973; Squires 1970; Suzynski 1971; Taylor 1971; Turnbull 1967; Van Gelder & Anderson 1967; Vance 1970; Wade 1972; Walker *et al.* 1968; Walters 1963; White & Grodhaus 1972; Whitehead 1971; Wood 1954; Wood *et al.* 1963; Yerke 1971.

2. Descriptions of computer programs: Addison *et al.* 1969; Anon. 1970b; Bachmann *et al.* 1973; Burton 1969; Chenhall 1972, 1975; Creighton & Crockett 1971; Creighton & King 1969b; Creighton & Packard 1974; Creighton *et al.* 1972; Cutbill 1971; Haglind *et al.* 1969; Hudson *et al.* 1971; Hull *et al.* 1970; Krauss 1973a; Pankhurst 1970b; Reddin & Feinberg 1973; Rickman *et al.* 1972.

3. Management of collection, museum, and specimen data: Albrecht & Skavanl 1974; Anon. 1970b, [date?]; Anderson 1962; Argus & Sheard 1972; Arnett 1969a; Beamen 1971; Berry 1970; Beschel & Soper 1970; Brenan 1974; Chenhall 1974, 1975; Creighton & Crockett 1971; Creighton & King 1969a; Creighton & Packard 1974; Crovello 1967, 1972a; Crovello *et al.* 1970; Cutbill *et al.* 1971; Cutbill & Williams 1971; Gomez-Pompa & Nevling 1973; Greene 1972; Hall 1972a, b, 1974; Heath 1971a, b; Johnson *et al.* 1971; King *et al.* 1967; Landrum 1969; Lewis 1967; MacDonald 1971; Manning 1969a; McAllister *et al.* 1972; Meikle 1971; Mello & Collier 1972; Morse 1974a; Perring 1963, 1967, 1971a; Reed *et al.* 1963; Shetler 1973, 1974; Shetler *et al.* 1973; Soper 1969; Soper & Perring 1967; Squires 1966, 1968, 1971; Suszynski 1971; Vance 1970; Walker *et al.* 1968.

4. Surveys, automated mapping procedures: Atmar *et al.* 1973; Brown 1964; Evans 1971; Gould 1968; Hawkes *et al.* 1968; Heath 1970, 1971a, b; Lieth & Radford 1971; Lloyd *et al.* 1972; Manning 1969a; Perring 1963, 1967, 1971a, b; Reed *et al.* 1963; Rensberger & Berry 1967; Soper 1964.

5. Automated identification procedures: Adams 1974; Anon. 1973; Atmar *et al.* 1973; Baker 1970; Bascomb *et al.* 1973; Boughey *et al.* 1968; Dallwitz 1974; Duke 1969; Gasser & Gehrt 1971; Germerad & Muller 1970; Goodall, 1968; Gyllenberg 1965; Hall 1970, 1973; Kendrick 1972; LaPage *et al.* 1973; Morse 1968, 1969, 1971, 1974b; Morse *et al.* 1968; Morse *et al.* 1971; Pankhurst 1970a, b, 1971, 1974; Pankhurst & Walters 1971; Soper 1966; Wilcox *et al.* 1973.

6. Automated catalogs, taxonomic catalogs: Arnett 1970c; Chenhall 1973, 1974, 1975; Krombein *et al.* 1974; Manning 1969b; Meikle 1971.

7. Bionumeric codes: Bullis & Roe 1967; Denmark *et al.* 1958; Gould 1954; Hull 1966; Jahn 1961; King *et al.* 1967; Little 1964; Manning 1969a; Michener 1963; Mullins & Nickerson 1951; Rabel 1940; Reed *et al.* 1963; Rivas 1965.

E. Personal information systems

1. Mechanical: Baker 1970; Brindley & Jones 1969; Bryan 1966; Byer *et al.* 1959; Duke 1969; Gould 1958; Levine 1955; Lloyd 1969; Morgans 1965a; Perdue 1964; Reichl 1963; Reinecke 1967; Shenefelt 1969; Van Gelder & Anderson 1967; Walters 1963; Wilcox 1968; Wood *et al.* 1963.

2. Automated: Bridges 1970; Burton 1969, 1973; Strand & Fribourg 1972; Travis *et al.* 1962; Yerke 1970; Yerke *et al.* 1969.